

SECTION M.15 HIGHWAY ILLUMINATION

M.15.01--General Requirements: The contractor may use material and products of any manufacturer provided they meet the design standards and are approved by the department. Materials requiring approval are as follows:

1. Light standards
2. Luminaires
3. Service Items
4. Junction Box
5. Single Conductor
6. Cable in Duct
7. Navigation Lights

M.15.02--Anchor Bolts:

1. Light Standard Base: Anchor bolts shall be high strength steel having a minimum yield point of 345 MPa. Each anchor bolt shall have a thread 150 mm long. The dimensions shall be as shown on the plans. A hexagon nut, hold down washer, and lock washer, shall be furnished with each bolt. The threads and hexagon nuts shall be hot-dip galvanized as per ASTM A 153.

2. Pedestal and Controller Foundation: The anchor bolts shall be ASTM A-36 steel rods having a minimum yield of 250 MPa. The dimensions shall be as shown on the plans. Each anchor bolt shall have a 90 degree bend at one end and shall be threaded at the other end for a sufficient length to properly mount the pedestal or controller. Threads, nuts, flat washers and lock washers shall be galvanized as per ASTM A 153.

3. Span Pole and Mast Arm Foundations: Anchor bolts shall meet the requirements of AASHTO Specification M 314. In addition, only Grade 55 or Grade 105 material may be used. The threaded end of Grade 55 material must be painted yellow. The threaded end of Grade 105 material must be painted red. Steel conforming to ASTM Specifications A 675 Grade 90, A 449 or A 687 is also acceptable and, if used, shall be clearly designated as such on the submitted shop drawings, and properly annotated on all certifications.

The chemical requirements for all categories are a maximum Phosphorous content of 0.04% and a maximum Sulfur content of 0.05%.

Anchor bolts shall have a diameter of at least 38 mm. The dimensions shall be as shown on the plans or as recommended by the manufacturer. Each anchor bolt shall be furnished with two nuts, two flat washers, and one lock washer. The threads, nuts and washers shall be hot-dip galvanized in accordance with the requirements for Class C of AASHTO M 232 (equivalent to ASTM A 153). The nuts shall conform to the requirements for nuts within AASHTO M 314.

Field welding and field bending of anchor bolts is prohibited. If anchor bolts do not fit with the base plate, the Contractor shall replace the foundation or use a remedy recommended by the pole manufacturer and approved in writing by the Engineer.

The Contractor shall ensure plumbness of the hooked anchor bolts in the foundation. A minimum anchor bolt embedment of at least 1.2 meters is required. The amount of threading shall be as shown on the typical drawings.

Bolt Sampling Requirements:

1. Submit samples marked by manufacturer or fabricator.
2. Submit one sample of each size and heat number.
3. Submit a proper Materials Certificate for each sample.
4. Submit a proper Certified Test Report for each sample.

M.15.03--Rock Anchors: Rock anchors shall be malleable iron dipped in corrosion-resistant asphalt paint.

M.15.04--Light Standards: (anchor base and transformer base), (aluminum).

- (a) **General:** Each light standard with appurtenances attached thereto shall be fabricated of aluminum alloy, designed and constructed in accordance with the plans and current requirements of AASHTO "Standard Specification for Structural Support for Highway Signs, Luminaires and Traffic Signals." Light standards with brackets and luminaires shall be designed to withstand a wind speed of 145 km/h.
- (b) **Base:** Light standard with transformer base shall conform to the breakaway requirements of the current AASHTO "Standard Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals" and shall be identified with visible markings. The transformer base shall be approximately 430 mm high with a door having an approximate opening of 250 mm X 300 mm.

A bonding lug shall be provided in each transformer base and each anchor base shaft shall have the handhole frame or anchor base tapped for bonding. All castings shall be clean and smooth with all details well-defined and true to pattern. It shall be the Contractor's responsibility to verify existing bolt circle diameters by field checking that the bolt circle of the light standard base will match the anchor base on the foundation or structure.

- (c) **Shaft:** Shaft shall be fabricated of aluminum alloy 6063-T6 or 6005-T5 as specified under AASHTO, current edition. Each shaft shall be seamless, tapered, circular in cross section. The shaft shall be one piece, however shafts over 12 m may be fabricated from two pieces and factory joined, welded, grounded to appear as one piece and have a smooth continuous finish.

Each shaft shall be designed and fabricated in such a manner that each shaft-bracket connection will accommodate single member type brackets 1 m to 2 m in length, or truss type brackets 3 m to 5 m in length. Each shaft designed to 1 m to 2 m single member bracket shall have the wall thickness of that required for the 2 m bracket, and each shaft for the 3 m to 5 m truss type bracket shall have the wall thickness of that required for the 5 m bracket.

Each shaft shall be provided with an aluminum pole cap with self tapping screws and an internal vibration damper. The internal vibration damper shall be factory installed, location and size as determined by the pole manufacturer.

The shaft shall be finished with a uniform surface having the natural color of aluminum. The shaft shall have a smooth, uniform finish, free from disfiguring scratches, dents and similar markings.

- (d) **Bracket Arms:** The bracket arms shall have an upsweep design and shall accommodate a 50 mm slipfitter type luminaire, fabricated of tubular elliptical aluminum which after fabrication shall have a mechanical strength not less than that of T-6 temper for 6063 alloy and T-5 temper for 6005 alloy. Truss type brackets shall have an aluminum end cap on the bottom member and a 4 mm weep hole located in the vicinity of the lowest point of the bottom member. The bracket arms shall be a truss-type for lengths 3 m and longer and shall consist of a single member for shorter lengths. The bracket arm shall be furnished with a finish similar to that of the shaft to insure uniformity of appearance. The maximum upsweep for brackets up to 5 m in length shall not exceed 1 m. Bracket arm lengths shall be as indicated on the plans.

- (e) **Handhole:** Each anchor base light standard shall have a handhole with a reinforced frame and cover approximately 100 mm X 150 mm located approximately 300 mm up from the base of the pole and placed 90 degrees from the bracket arm on the far side of the traffic flow.
- (f) **Isolation Pad:** Each light standard mounted on any bridge structure shall have 12 mm thick elastomeric pad of the same surface area as pole base, installed between the pole base and the structure, with four 10 mm thick by 50 mm O.D. minimum elastomeric washers installed on the top side of the base, between two standard galvanized flat washers. Elastomeric pads and washers shall conform to Article M.17.01.
- (g) **Hardware:** All screws, nuts, bolts, washers and miscellaneous hardware used to assemble the light standard, base and brackets shall be stainless steel with the exception of washers and nuts for anchor bolts. Stainless steel bolts and washers shall conform to the requirements of ASTM A193, Grade B8. Stainless steel nuts shall conform to the requirements of ASTM A194, Grade 8.
- (h) **Design Requirements:** The pole manufacturer shall certify on the catalog cuts or shop drawings that the light standard, with appurtenances, conform to all pertinent requirements of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" including the latest AASHTO breakaway requirements and in accordance with definition given to the latest edition of AWS, as specified under AASHTO, Section 5, Article 1.5.5., Fabrication of Welded Aluminum Structure.

M.15.05--Roadway Luminaire: The luminaire shall be of the "cobra-head" type for roadway lighting with gray finish. The housing shall be die-cast aluminum with refractor door hinged on one end and latched on the other. It shall have a 50 mm slip fitter for end mounting and factory-installed bird guard. Reflector is to be aluminum, refractor to be glass. The optical assembly shall have a captive, non-wicking gasket to filter air. There shall be no photoelectric control receptacle unless specifically required for the application, and there shall be no open holes in the housing. The socket shall be porcelain enclosed for mogul base lamp and adjustable to provide IESNA Light distribution type as shown on the plans.

The integral ballast shall be the regulator type with high power factor (above 90%) and in full compliance with current ANSI lamp/ballast specifications. Starting current shall be less than operating current. The ballast shall be capable of starting and operating a specified lamp at -28° C. The unit shall be designed to operate under ±10% line voltage variation. The ballast shall operate at the specified circuit voltage. The entire ballast and starter unit shall be prewired and quick-disconnect type for ease of maintenance.

Conductors shall be #10 AWG in accordance with Article M.15.11. Insulation shall be THHN.

The breakaway-type fuse holders shall be of rubber or molded plastic housing which is watertight, as detailed on the plans. They shall be rated at 600 volts. Fuses shall be UL listed, fast-acting, current-limiting and rated at 10 amp, 600 volt and 100,000 AIC.

The luminaire shall have an identification sticker indicating the lamp type and wattage located on the underside of the luminaire, in accordance with current ANSI Standards.

The lamp shall be all position of the source and wattage called for on the plans, and in accordance with the current ANSI specification. The lamp shall be new and unused at the time of installation.

M.15.06--Vacant.

M.15.07--Underbridge Luminaire: The luminaire shall be wall or pendent mounted with distribution type, wattage and voltage as specified on the plans.

The wall mounted luminaire shall be complete with an optical assembly consisting of an anodized aluminum reflector and a single piece prismatic refractor made of thermal shock-resistant borosilicate glass protected by a clear polycarbonate shield. If specified, a steel wire guard shall be placed over the polycarbonate shield or used in lieu of the

polycarbonate shield. The door shall be die-cast aluminum, self-hinged and secured by two captive stainless steel threaded fasteners. The housing shall be die-cast aluminum with a 19 mm threaded top entry and a captive non-wicking filtering gasket against which the door shall seat when closed. The luminaire shall provide a maximum vertical candle-power under 75 degrees and shall be UL listed as suitable for wet locations.

The pendant mounted luminaire shall be complete with a prismatic polycarbonate refractor and UL listed as suitable for wet locations. The housing shall be die-cast aluminum with a 32 mm threaded top entry and a die-cast aluminum refractor holder hinged to the luminaire housing in a manner that allows easy removal of the assembly. The refractor shall be securely held by means of a stainless steel hinge and a positive acting spring loaded latch which will permit single action release and closing with a snap action.

The lamp socket shall have a porcelain enclosed mogul base. The socket for a pendant mounted luminaire shall be adjustable to provide the IESNA light distribution type called for on the plans.

The integral ballast shall be the regulator type with high power factor (above 90%) and in full compliance with current ANSI lamp/ballast specifications. The ballast shall be capable of starting and operating a specified lamp at -28° C. Starting current shall be less than operating current. The unit shall be designed to operate under $\pm 10\%$ line voltage variation. The ballast shall operate at the circuit voltage specified on the plans. The entire ballast and starter unit shall be prewired.

Conductors shall be #10 AWG, 600V, in accordance with Article M.15.11. Insulation shall be THHN.

Fuse holders shall be of rubber or plastic molded housing which is watertight and shall be used in each branch circuit supplying a luminaire or luminaires. They shall be rated at 600 volts. Fuses shall be UL listed, fast-acting, current-limiting and rated at 10 amp, 600 volt and 100,000 AIC.

Mounting materials and hardware shall be as indicated on the plans or as directed by the Engineer.

Conduit shall be in accordance with Article M.15.09.

The luminaire shall have an identification sticker indicating the lamp type and wattage in accordance with current ANSI Standards.

The lamp shall be all position of the source and wattage called for on the plans, and in accordance with the current ANSI Standard. The lamp shall be new and unused at the time of installation.

M.15.08--Vacant.

M.15.09--Electrical Conduit:

1--Rigid Metal Conduit: Rigid Metal Conduit (RMC) and fittings shall be galvanized steel. Each section of conduit shall be labeled as UL listed, and shall conform to the requirements of the latest UL and ANSI standards for Rigid Metal Conduit. Set-screw or compression fittings shall not be used.

2--Intermediate Metal Conduit: Intermediate Metal Conduit (IMC) and fittings shall be galvanized steel. Each section of conduit shall be labeled as UL listed, and shall conform to the requirements of the latest UL and ANSI standards for Intermediate Metal Conduit. Set-screws or compression fittings shall not be used.

3--Polyvinyl Chloride Conduit: Polyvinyl Chloride Conduit (PVC) and fittings shall be UL listed, and shall conform to the requirements of the latest UL and ANSI standards for Polyvinyl Chloride Conduit. Schedule 40 grade shall be used where underground, Schedule 80 grade shall be used on surface.

4--Liquid Tight Flexible Metal Conduit: Liquid tight flexible metal conduit shall consist of a continuous strip of flexible galvanized metal, coated with an extruded jacket of polyvinyl chloride. Liquid tight flexible metal conduit shall be suitable for use in wet locations and shall meet the requirements of the latest UL and ANSI standards for liquid tight flexible metal conduit.

M.15.10--Cast Iron Junction Box: Junction Boxes shall be cast iron constructed to NEMA Type 4 requirements. The junction box cover shall be attached with approved stainless steel bolts and sealing washers, and shall be equipped with a neoprene cover gasket. For a 450 mm X 300 mm X 200 mm cast iron junction box, cover bolts shall be 6 mm X 16 mm; threads shall be 20 N.C.; and the head shall be hex type and shall accept a 11 mm socket.

The covers for cast iron junction boxes shall be 6 mm thick steel conforming to the requirements of ASTM A 36 and shall be galvanized in accordance with ASTM A 123. Holes for the cover bolts shall be recessed in the cover plate to accept a 11 mm socket wrench.

All junction boxes recessed in concrete shall have an outside flush flange with a recessed cover and the conduit entrance holes shall be slip fit.

Junction boxes which are for surface mounting shall have threaded hubs or threaded bosses with a minimum of five full threads. All boxes and covers shall be hot-dip galvanized conforming to the requirements of ASTM A 153.

Rigid metal conduit for drain pipe shall conform to the requirements of Article M.15.09-1.

M.15.11--Single Conductor:

1--Insulation: Insulation type, size, and voltage rating shall be as shown on the plans. Insulation shall be permanently color identified throughout its entire length. Color shall be as called for on the plans. A green, white or natural gray color shall not be used unless it is a grounded conductor. The rating, type, size, and manufacturer shall be durably marked in accordance with the NEC.

2--Conductor: Conductors shall be single conductor, stranded, copper, meeting the latest ICEA, UL, NEMA, and FS for the type specified.

M.15.12--Cable in Duct: The materials for this item shall consist of single conductors in a flexible non-metallic conduit, the whole unit shall be pre-assembled for direct burial. The size, number and type of single conductors shall be as called for on the plans and shall conform to Article M.15.11. The conductors shall be laid parallel, not twisted, so they may be individually removed.

The duct size shall be governed by the number and size of the single conductors contained as listed below. Nominal duct size shall be as follows unless otherwise noted on the plans:

32 mm with minimum bending radius of 460 mm for up to four No. 2 conductors.

50 mm with minimum bending radius of 600 mm for more than four No. 2 conductors and through four No. 2/0.

The duct material shall be polyethylene and meet the requirements of Schedule 40. The duct shall meet all applicable standards of the latest NEMA Standard Publications no. TC-2 and TC-7.

M.15.13--Bare Copper Grounding Conductor: The conductor shall be 7-strand, soft-drawn, bare copper wire of the size specified on the plans.

M.15.14--Vacant

M.15.15--Service Entrance Cabinets:

1--Cabinets: The service entrance cabinet and the lighting control cabinet shall be sheet aluminum and conform to NEMA type 3R enclosure requirements. Type and dimensions are as called for on the plans. The doors shall be hinged, weatherproof gasketed, with handle and Conn-1 lock for the lighting control cabinet, and a stainless steel door handle with hasp for utility company padlock for the service entrance cabinet. The cabinet shall have a full-size backboard of 19 mm smooth marine grade plywood, painted black.

2--Instrument Transformer Cabinet: The instrument transformer cabinet shall conform to the requirements for the service cabinet.

3--Meter Socket and Enclosure: The meter socket and enclosure shall conform to utility company specifications.

4--Pedestal: For pedestal mounted cabinets, the pedestal shall conform to Article M16.03.2.

5--Foundations: Concrete shall conform to Article M.03.01--Class "A." Anchor bolts shall conform to Article M.15.02.2. Pedestal foundation may be precast.

6--Transformer Pad: Concrete shall conform to Article M.03.01--Class "A." The pad may be pre-cast. This item shall conform to Utility Company requirements.

7--Ground Rod: The ground rod shall be dimensioned as shown on the plans, copper clad steel. The clamp shall be a square head bolt type.

8--Conduit: Conduit shall be of the type called for in the plans and conform to Article M.15.09.

9--Conductors: Conductors shall conform to Article M.15.11.

10--Photoelectric Control: The photoelectric control shall have an adjustable turn on setting set at approximately 20 lux with a time delay of at least 3 to 5 seconds. The control relay shall have single pole double throw contacts rated for 1000 watts. The coil shall operate at 120 Volts AC. It shall be applicable to the electrically operated, mechanically held contactor. Conductors shall be #12 AWG conforming to Article M.15.11. The manual switch shall be a three-way toggle switch mounted in a single gang utility box.

11--Contactor: The control contactor shall be of the size, rating and number of poles, as shown on the plans. It shall be electrically operated (120 volt), and mechanically held.

12--Control Transformer: The transformer shall be dry type, single-phase, two winding for wall mounting, of the size rating and voltages as called for on the plans.

13--Circuit Breakers: Circuit breakers shall be thermal magnetic type, non-enclosed, front-connecting, for mounting to the backboard. The number of poles, voltage rating and current rating shall be as shown in the plans.

14--A utility light shall be mounted in the cabinet with porcelain or plastic base, pull chain and incandescent lamp.

15--Ground Fault-Circuit Interrupter Receptacle: The ground fault-circuit interrupter receptacle shall be 20 amp, 125 volt, 60 HZ Class A, and shall be UL listed.

16--Main Disconnect Safety Switch: The main disconnect safety switch shall be a heavy-duty, non-fusible, three pole, single throw switch, with a manual lever, appropriate service grounding kit, rated for 480 volts, with a current rating as shown on the plans, NEMA Type 1 housing, UL-listed, and suitable for use as service equipment.

M.15.16--Navigation Light: The navigation light shall be of a type approved by the United States Coast Guard and shall be in accordance with their regulations for lighting bridges.

The navigation light shall be made with a bronze casting and shall be entirely weatherproof. It shall be ventilated to prevent sweating of the lens, and the vent shall be screened to prevent entry of bugs and insects. All parts of the lamp shall be interchangeable so that each lamp can be assembled with a 180-degree or 360-degree 200 mm fresnel lens.

Each navigation light shall be equipped with two 100 watt, 120 volt lamps and a lamp failure relay. The green navigation lights shall have a 360 degree green fresnel lens. The red navigation lights on the structure or pier shall have 180 degree red fresnel lens.

Flexible cords shall be type S.O. three conductor #10 AWG rated at 600 volts.